

## **ALCOHOLIC BEVERAGE CONSUMPTION\***

First listed in the *Ninth Report on Carcinogens*

### **CARCINOGENICITY**

Consumption of alcoholic beverages is *known to be a human carcinogen* based on sufficient evidence of carcinogenicity from human studies that indicate a causal relationship between consumption of alcoholic beverages and cancer in humans (reviewed in IARC V.44, 1988; Longnecker and Enger, 1996). Studies indicate that the risk of cancer is most pronounced among smokers and at the highest levels of consumption.

Consumption of alcoholic beverages is causally related to cancers of the mouth, pharynx, larynx, and esophagus. Cohort and case control studies in a variety of human populations are notable for their consistency in reporting the presence of moderate to strong associations with dose-response relationships for these four sites. Evidence also supports a weaker but possibly causal relation between alcoholic beverage consumption and increased risk of cancers of the liver and breast (Longnecker, 1994). The effect of a given level of alcoholic beverage intake on absolute risks of cancer of the mouth, pharynx, larynx, and esophagus is influenced by other factors, especially smoking. However, smoking does not explain the observed increased risk of cancers associated with increased alcoholic beverage consumption.

No adequate experimental animal carcinogenicity studies of alcoholic beverages have been reported in the literature. Studies specifically examining the carcinogenicity of ethanol in animals have not yielded results that would suggest that the ethanol component of alcoholic beverages is solely responsible for the increases in cancer observed in people consuming alcoholic beverages.

### **ADDITIONAL INFORMATION RELEVANT TO CARCINOGENESIS OR POSSIBLE MECHANISMS OF CARCINOGENESIS**

Increased frequencies of chromosomal aberrations, sister chromatid exchanges, and aneuploidies have been found in the peripheral lymphocytes of alcoholics. Ethanol-free extracts of some alcoholic beverages induced sister chromatid exchanges in human cells *in vitro* and mutations in bacteria (IARC V.44, 1988).

The mechanism by which consumption of alcoholic beverages can cause cancers in humans is not established.

### **PROPERTIES**

Ethanol and water are the main constituents of most alcoholic beverages. The amount of ethanol consumed in a standard measure of most drinks is similar for beer, wine, and spirits (10-14 g). The ethanol in these beverages comes from the fermentation of carbohydrates by yeast.

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\* There is no separate CAS registry number assigned to alcoholic beverages.

Although ethanol can be chemically synthesized from ethylene, alcohol synthesis for use in beverages is not employed by the alcoholic beverage industry because of the presence of impurities from the synthetic process (IARC V.44, 1988).

Beer, wine, and spirits also contain volatile and nonvolatile flavor compounds that originate from raw materials, fermentation, wooden casks used for maturation, and synthetic substances added to specially flavored beverages. The exact composition of many beverages is confidential business information, though much published data defines the organic compounds usually present at low levels. Several of the components and contaminants identified in beer, wine, and spirits are known or suspected human carcinogens, including acetaldehyde, nitrosamines, aflatoxins, ethyl carbamate (urethan), asbestos, and arsenic compounds (IARC V.44, 1988; NTP, 1998).

## USE

The IARC monograph described in detail the use of alcoholic beverages. Consumption trends, including overall level of alcohol consumption, beverage choice, age and sex differences, and temporal variations, differ among and within societies. Patterns of alcohol consumption have been observed to vary on a global scale, largely independent of regional differences or economic and social changes (IARC V.44, 1988).

A downward trend in alcohol consumption was observed in the United States and many European countries from the turn of the twentieth century until the period between the world wars. Alcohol consumption then increased, approaching the peak levels of the nineteenth century, until the 1970s and 1980s, when consumption rates slowed, leveled off, or, for the United States, decreased (NIAAA, 1997).

Alcohol consumption in the United States increased from the 1940s until the early 1980s, then began to decrease steadily; by 1993, consumption had declined to the lowest level since 1964. Per capita consumption figures were derived by estimating total alcohol use, based on sales and shipment data, of the U.S. population aged 14-years or older. Apparent per capita consumption expressed in gallons of pure alcohol was 1.6 in 1940, ~2.2 in 1964 and 1993, and ~2.8 ca. 1980 (NIAAA, 1997).

A 1990 National Alcohol Survey gathered data regarding the demographic distribution of drinking patterns in the United States (Midanik and Clark, 1994). Respondents were classified as current drinkers (any use of alcohol beverages in the preceding year), weekly drinkers (any alcoholic beverage use at least weekly during the preceding year), and drinkers of five or more drinks (drinking five or more drinks on one occasion weekly or more often during the preceding year). Of the men surveyed, 71.2% were current drinkers, 40.0% were weekly drinkers, and 6.5% were in the five drinks group. In the group reporting the highest alcohol consumption, men aged 18-29, 76.5% were current drinkers, 44.4% were weekly drinkers, and 11.0% were in the five drinks group. The same age group reported the highest consumption among women: 69.7% were current drinkers, 19.7% were weekly drinkers, and 3.0% were in the five drinks group. When data from all age groups of women were combined, 59.4% were current drinkers, 18.8% were weekly drinkers, and 1.4% were in the five drinks group. These figures all represent decreases in alcohol consumption as measured by a similar survey conducted in 1984. Respondents were grouped by ethnicity and religious affiliation. The survey found no statistically significant differences in alcohol use among ethnic groups, but conservative Protestants reported significantly lower alcohol consumption in all three categories (Midanik and Clark, 1994).

Per capita consumption of wine and beer in the United States was relatively stable over the period beginning in the early 1980s and continuing into the 1990s when overall alcohol consumption was falling (Williams et al., 1995; cited by NIAAA, 1997). Most of the decrease in U. S. alcohol consumption can be attributed to decreased consumption of spirits. Though wine has made much less of a contribution to the total volume of U.S. alcohol consumption than beer or spirits, per capita consumption of wine was the same in 1993 as it was in 1977, while consumption of spirits fell by almost 35% over the same period. Per capita consumption of beer decreased from 1981 to 1985, fluctuated thereafter, and in 1993 was 1% below 1977 consumption levels (NIAAA, 1997).

## PRODUCTION

All alcoholic beverages are produced by the fermentation of fruit or other vegetable matter. Most commercial and home production involves fermented beverages that are classified, based on raw materials and production methods used, as beer, wine, or spirits, although smaller quantities of other kinds of fermented beverages (cider, rice wine, palm wine, etc.) are also produced. Beer is produced by fermentation of malted barley or other cereals with the addition of hops. Wine is made from fermentation of grape juice or crushed grapes; fortified wines include additional distilled spirits. Distilled spirits, so named because of liquid distillation after sugar fermentation to increase the alcohol content, originate from sources of starch or sugar, including cereals, molasses from sugar beets, grapes, potatoes, cherries, plums, and other fruits (IARC V.44, 1988).

In 1990, American wine production was 4,520 thousand Mg, beer production was 374,529 thousand hectoliters, and spirit production was 18,454 thousand hectoliters (ARF, 1994). World total production of the same beverages was 29,010 thousand Mg, 1,088,742 thousand hectoliters, and 57,756 thousand hectoliters, respectively.

## REGULATIONS

A March 1999 search of the most recent editions of the *Code of Federal Regulations* found no regulations requiring warnings on alcoholic beverage labels of an increased risk of cancer due to alcoholic beverage consumption. (Labels on saccharin-containing wines, distilled spirits, and malt beverages, however, must warn of a cancer risk from saccharin consumption [27 CFR 4.32, 5.32, and 7.22, respectively, enforced by the BATF (Bureau of Alcohol, Tobacco and Firearms), Department of the Treasury]).

FDA regulates health claims information on food labels. Thus, labels on low fat foods may make the health claim that diets low in fat “may” or “might” reduce the risk of some cancers with several provisions (21 CFR 100.73 Health claims: dietary lipids and cancer). Optional information allowed includes identification of risk factors for development of cancer. Alcohol consumption is one of the risk factors that FDA lists. The same optional information may be added to labels stating there is a reduced risk of cancer for diets high in fiber-containing grain products, fruits, and vegetables (21 CFR 101.76, 21 CFR 101.78).